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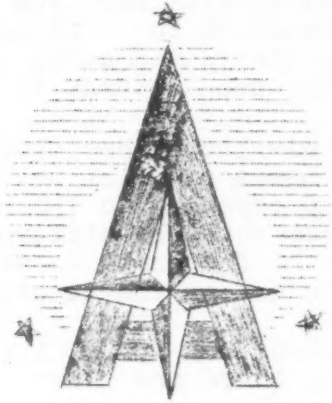

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LIFE ON MARS by Dr. Nicholas Zhirov

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LIFE ON MARS

It has generally been assumed that life, as we know it, would not be possible on Mars owing to the lack of suitable atmospheric conditions. The problem of providing a breathable framework for a planet where most of the gases have been dissipated owing to the small force of gravity has always been assumed to be insuperable.

Dr. Zhirov in his thesis has, however, managed to work out a logical basis on which not only life but organisms having the capacity to think might well exist. That their metabolism would be different to ours is obvious, but it would be dangerous to assume that for this reason life would be out of the question.

In any given planetary system life should be possible on the second, third and fourth planets, in our case Venus, Earth and Mars. This is because according to Bode's Law and the various adjustments which have been made to it, the distances of planets from their central sun follow a recognisable pattern into which human types of life could fit with a certain amount of adjustment.

Bearing in mind that there are several million planetary systems in our own galaxy, the Milky Way, the potentialities for the future are extremely interesting.

The article which follows deals with this theme and we are very grateful to Mr. Godlewski for his excellent translation of a paper on a difficult subject.

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CONDITIONS FOR THE EXISTENCE OF INDIGENOUS THINKING BEINGS ON MARS

An Atmosphere of Heavy Inert Gases as an Essential Condition for this

by N.F. Zhirov, Doctor of Chemistry

Translated by J. Godlewski

At the present time various thoughts and hypotheses in favour of the existence of life on Mars are being expressed more and more frequently. The higher development of modern science and technical knowledge has permitted the reaching, from an entirely different point of view, of opinions which would have been considered absolutely fantastic a few dozen years ago. One such idea is that of the possibility of the existence of thinking beings on Mars; a hypothesis which has a history of nearly a century. Unfortunately on one hand, there has usually been uncritical enthusiasm for such an attractive notion and on the other hand severe criticism caused mainly by a voluntary or involuntary transposition of conditions for life on Earth as conditions for life on Mars. Therefore today the orthodox scientists (e.g. V.G. FESENKOV) generally deny the possibility of any life on that planet, not to mention thinking beings.

The existence on any cosmic body of highly organised life similar to (but not necessarily identical with) that on Earth and the existence of albumenous and other organic substances, without which the creation of life would be unthinkable, depends on the presence of:- (a) a suitable atmosphere, (b) moisture, (c) conditions of temperature, (d) means of nourishment. Modern scientific data has this to say on these matters:- (a) the temperature conditions if the southern hemisphere of Mars, particularly in the locality of its equatorial region, can maintain organic life. During the summer the surface temperature of the equatorial zone rises to 20°-30° C in the day time. (b) Water and

water vapour have not been detected by direct astronomic spectroscopic observation of Mars. But then the scientific methods at present available have not discovered water on any body in the solar system (with the obvious exception of the Earth). But in favour of the existence of water (possibly in the form of some kind of cryohydrate) [1] there is the presence of the polar caps and their seasonal changes and of white-coloured cloud formations, which cannot be dust clouds. (c) at the present time it is almost impossible to doubt that there is natural growth on Mars. G.A. Tikhov, a founder of astrobottany, who died recently, introduced in his time many considerations which favoured the possibility. The recent observations of W.M. Sinton discovered the presence of an absortion of 3.5 microns in the spectrum of the reflection from the warm region of Mars, which correspond to the frequency of molecules of organic substances of the S-N group. This absortion is identical with that observed in furs and lichens on Earth. (d) in relation to the composition of the atmosphere, the only concrete data points to the indubitable presence of Carbon Dioxide, even in quantities twice as large as those on Earth. This itself confirms the posibility of the existence of vegetation which achieves its nourishment by means of photosynthesis, although not necessarily with the aid of chlorophyl, this follows from the fact that, at the distance separating Mars from the Sun, the intensity of the light is much less and so the absortion of light of a long wave length is required for photosynthesis. Therefore H.A. Kozirev suggests that vegetation of Mars is black in colour. This opinion is supported by the absence of colour in the dark "seas" of Mars.

The presence of oxygen in the Atmosphere of Mars (as by the way on all planets except the Earth) has not been successfully detected with absolute certainty.

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1. According to the latest report of Prof. D.Y. Martinov water vapour has been detected in the atmosphere of Venus in the same quantities as on Earth. This report requires further confirmation in the future.

True, as early as 1926 W.S. Adams and C.E. St. John found that its quantity was equal to $\frac{1}{3}$ of that on earth (that is somewhat less than 1.5%) but no one has succeeded in confirming this data, nor have they succeeded in finally disproving it. Therefore on the basis of a rather hypothetical calculation it is supposed that the oxygen in the Martian atmosphere is less than 0.1%. As far as Nitrogen ic concerned, it, like other inert gases, cannot be detected by the methods of modern astronomic spectroscopes. Therefore all consideration of the composition of these gases is pure speculation besides being based on insufficiently critical transposing of conditions on Earth to Mars.

A series of indirect observations show that in the atmosphere of Mars there must be a substance which is not normal on Earth, or normal but under abnormal conditions. This is supported by the following:-

(a) The low reflecting quality of the polar cap (30%) and its voilet-blue colour.

(b) The existence of so-called "violet clouds" (ozone under some particular conditions?)

Reconsidering everything said above, one may come to the conclusion that, if we rid ourselves of preconceptions based on the Earth, it is possible to reckon on the basis of present data, that there exists on Mars such conditions of temperature, moisture and means of nourishment for there to be a possibility of existence of even thinking beings of indigenous evolution (Martians).

To tackle the problem which faces us, let us make the following postulations.

1. The areological history of Mars differs radically from the geological history of the Earth. This is particularly supported by the completely plain surface of Mars, which in no way compares with the surface of the Earth. For the latter bears the imprint of all the previous history of the Earth! The lack of water on Mars itself excludes supposition that its surface has been levelled by water erosion. Atmospheric erosion alone could hardly produce such levelness. The conclusion, made on this basis, that Mars is older than

the Earth is highly debatable.

2. Despite the absence of mountains we consider it possible that depressions of a large size exist on Mars, the depth of which may reach the order of 20 k.m. The darker regions of Mars (The "Seas") according to our ideas, are deep depressions between very level projecting plateaux. It is extremely difficult to determine the depths of these depressions. For the fact is that the image of Mars which is obtained with even the most powerful telescopes is not very large (1-2 m.m.), and even when magnified by optical receivers does not exceed a few centimetres. With the diameter of Mars about 6,780 kilometres, a depression with a depth of even 20 Km will appear on an image of say 30 m.m. as only 0.1 m.m., and this lies at the limit of what photographic materials can define. On the other hand the presence of such depressions with sloping sides, which do not give a sharp shadow, can be detected only when the depression comes on to the edge of the planet. But such observation is extremely difficult, for the thickness of the atmosphere interferes, giving a lack of definition, and in photography an aureole at the edge is produced in developing the film.

3. The smaller size and mass of Mars by comparison with the Earth means that the force of gravity amounts only to 40% of that of the Earth. This must make a marked difference to all conditions of life on Mars in comparision with the Earth, namely the rate of physical and chemical processes and of life. The smaller force of gravity must make a totally different imprint on everything that happens and has happened, on this planet, and does prohibit transposing Earth's conditions to Mars, even as a first approach. Very often we do not sufficiently understand this and do not visualise sufficiently clearly the huge significance of this fact.

1. <u>The problem of Oxygen on Mars</u>.

For the life of high organised creatures, particularly for thinking ones, the presence of oxygen is absolutely essential, primarily because the process of oxidisation is the main source of energy for living

organisms capable of independent movement. It follows that we should first calculate, though very roughly, the quantity of oxygen that there must be on Mars to support the life of thinking beings of indigenous evolution. Let us emphasise that we mean Martians and not people as they exist on Earth, since conditions for life on Mars throughout all the epochs of its existence have differed markedly from those on Earth, mainly as a consequence of the lower force of gravity, which as we know is only 2/5 of the force of gravity on Earth. From this follows that a living creature under conditions otherwise equal to those on Earth will require to expend 40% of the energy he would use on Earth to do any work connected with overcoming gravity (that is, in fact the production of all heat not required for maintaining body temperature).

The considerably lower average yearly temperature of the warmer regions of Mars permit the assertion that warm blooded living beings, on that planet must have a much lower body temperature than those on Earth. There are many reasons for supposing that on Earth man, is indigenous to its tropical regions. It is reasonable therefore, that Martians should also be indigenous to the warmer regions of the Southern hemisphere of Mars. But the average temperature of these regions is in the order of 10 - 15° (C) as opposed to 20 - 25° of the tropical regions of the Earth; that is, almost half as high. If man on Earth has a body temperature 10° higher than the average temperature of the tropical regions then by applying the analogy to Martians they should have a body temperature of 25°. At such a temperature, even with Earth man the majority of biological processes continue more or less normally for a time; as we know from the experience of operations performed by certain surgeons when the human body has been cooled to a low temperature. The bodies of Martians could, in the process of evolution, have adapted themselves completely for normal existence at such temperatures. Of course in such cases many of the processes of living will (from our point of view) take place in an altogether different way from those on Earth, but it is highly probable that the considerably smaller force of gravity in part

compensates for this. It is also suggested that the mechanism for maintaining the Martians' body temperature will have a somewhat different form, permitting for example an actual difference of temperature in the various organs of his body. It may be that, for these reasons, the evolution of living beings on Mars has proceeded at a slower tempo than on Earth, and so the development of thinking beings has also taken place much slower than on Earth.

Considering all that is mentioned above, it is possible with certain accuracy, to suppose that 40% of the amount of oxygen in the Earth's atmosphere would probably be sufficient for Martians, i.e. only 8% oxygen would be sufficient to support life in thinking beings under the conditions existing on Mars. It may be, that as in humans, a somewhat increased proportion of carbon dioxide in the atmosphere of Mars stimulates the Martian's breathing.

The acceptance of this conception permit us to approach the dark areas ("Seas") of Mars from a rather different point of view. These areas, which are completely covered with vegetation, may be considered as "oxygen factories" replenishing the natural losses of oxygen by means of photosynthesis. There is every reason to suppose that this is "one-day" vegetation since only growth with a one-day cycle of existence would be sufficiently equipped for the sharp changes of temperature between day and night, which may have an amplitude reaching up to 60-90°. It is difficult to visualise what plant biological processes could contrive with temperatures much below 0° C. A feature of such plants, in distinction from those on Earth, is that being "generators of oxygen" they do not use it up at night, as plants do on Earth. Therefore it would be reasonable for the Martians to develop such plants in some way or another even if they didn't exist from the beginning. It may even be supposed that a sort of growth would be developed by selection or other agro-technical methods, which would give off large quantities of oxygen. We do not know of any such plant life and generally speaking, the Earth's vegetation has not been studied from this point of view, because conditions of life on Earth do not demand the

same attention to economy of oxygen as those on Mars. It is possible that the so-called "canals" on Mars are also connected with the problem of vegetation and oxygen and are either a natural or an artificial system serving not only to bring moisture from the poles of the plant, but also carbon dioxide for feeding plants; of the gas coming from the depth of Mars through cracks and crevices.

Now let us turn to the question of why oxygen hasn't so far been discovered in the atmosphere of Mars. This may be due to various reasons, without taking into consideration the imperfection of present day astrospectroscopic methods as a means of observation. Firstly since the source of oxygen on Mars (as on Earth) is plant life - one-day plant life; then the amount of it in the oxygen must change markedly, increasing towards the end of the day and dropping sharply towards the end of the night and the early day time. This in itself makes the conditions for observing it much worse.

Secondly oxygen must be concentrated in the lowermost part of the atmosphere of Mars, mainly in the depressions, thus making its discovery much more difficult.

And finally, a third point, there may exist that phenomena, which V.A. Fursovim has suggested to explain the possibility of the existence on Venus of lighter oxygen in the lower layers of the atmosphere and of heavier carbon dioxide in the upper layers. His explanation is that the rising stream of warm air supports heavier gases than the layers of cold air which surround it. V.A. Fursovim points out that even under conditions existing on Earth warm carbon dioxide tries to rise upwards. In the case of Mars, with its smaller force of gravity, this process, if it takes place, should occur all the more strongly. From this point of view it is reasonable to re-word the question as, "What heavy gases may there be on Mars?"

2. Inert gases as the Basic Component of the Atmosphere of Mars.

Our previous considerations lead to the conclusion that heavy gases must play an important, if not a dominating role, in the Atmosphere of Mars. However there

is much less C.O.$_2$. than on Venus and therefore on Mars heavy inert gases must serve in this capacity. But we may reach the same conclusion from other considerations.

Since it posses a smaller mass than the Earth and a smaller gravitational force Mars must, as a natural consequence of this, have an atmosphere of rich heavy gases. The "rate of escape" of gases in the case of Mars is somewhat less than a half of that for Earth. True this rate is still sufficiently high to hold back nitrogen and oxygen, but the leaking away will go on at the same time as the process of ionisation in the upper layers of the atmosphere. But if the proportion of oxygen is not great (as we have accepted above), and the remainder of the atmosphere consists of gases of a considerably higher density, then oxygen will leak away from such an atmosphere quite slowly. Under the conditions existing on Mars such characteristics would belong to an atmosphere of the heaviest inert gases, krypton, argon and xenon, particularly the latter two. The properties of these gases, by comparison with oxygen and air, as far as they concern our purpose, are set out in the table below.

	Air	Oxygen 02	Argon Ar	Krypton Kr	Xenon (Xe)
Density	1.00	1.10	1.38	2.86	4.49
Thermalconduction	100	100	69	32	21
Specific heat at a constant pressure	0.24	0.24	0.13	0.06	0.04
Potential for ionisation	-	13.6	15.7	13.9	~10.0
Proportion in the Earth's air as a % of volume, according to F. Paneth	-	21.0	0.93	0.00001	0.000008
Proportion in Cosmic space (Silicon = 10000 atoms) according to H. Brown	-	12500	1000	0.87	0.15

It is difficult to say anything precise, concerning the role of ionisation processes, since there are amongst the heavy inert gases, both those with a potential higher

than that of oxygen and those with a lower potential.

Voculaire suggests, that the amount of argon in the atmosphere of Mars is only 1.2% and that 98.5% of the atmosphere consists of nitrogen. Unfortunately these figures are mostly hypothetical since it is very difficult to determine the amount of nitrogen in a planet's atmospheres, by modern astrospectroscopic methods. As far as inert gases are concerned, as a result of their single atom structure there is no "belt of absorption" in the spectrum, such as exists in the case of water vapour, carbon dioxide, and oxygen. Also their potential for ionisation is generally sufficiently high, possibly with the exclusion of Xenon, whose radiation is probably bound up with the mysterious night luminosity of the atmosphere of Venus. Therefore we cannot at the present time determine qualitively the presence of inert gases in planets' atmospheres. Any data which you may come across about the proportions of these gases in the atmospheres of planets of the Solar system is based on purely hypothetical ideas and a transposing of data about the Earth's atmosphere to other planets, including Mars, and there is no foundation for this. At the same time the disposition of inert gases in the cosmos is sufficiently great. In this connection H. Brown writes "It would be surprising from the point of view of the physics of the nucleus if the rare gases were no less frequent than the other elements which come next to them in the Periodic Table". Therefore argon, for example, must, according to G.P. Kuiper's data, be as wide spread in the cosmos as at least calcium, sodium, chlorine, aluminium and nickel. In fact L.H. Allen and D.H. Menzel detected a considerable quantity of argon in the planetary nebulae. It was also detected in the Sun's corona. As far as the heaviest inert gases are concerned their proportion in the cosmos (data given in the table) according to H. Brown was calculated working on the premise that their prevalence in relation to say argon was in the same proportion as on Earth. But this suggestion also seems to be without sufficient foundation. Inert gases have a more stable configuration, which other elements try to arrive at by diverting themselves off or joining up with external

electrons. Even on the basis of this simple suggestion it would follow that they should be expected to be quite prevalent in the cosmos. The considerably greater rarity of Krypton and Xenon is usually explained as due to the fact that elements with even mass numbers generally occur more frequently in nature than those with odd numbers. But even amongst the Xenon on Earth we find mainly the even isotope Xe^{132} and then the odd isotopes Xe^{129} and Xe^{131}. Similarly more of the even numbered Xe^{134} and Xe^{136} are found in stable isotopes of the substances resulting from the radioactive disintegration of Uranium than any other substance. In this case the emission of Krypton is lower and Xenon higher, according to N. Thode. It is necessary to point out that we do not know the sources from which cosmic inert gases come, with the exclusion of Helium and, in part, of Neon. It is not known whether the heavier inert gases resulted from radioactive disintegration or, on the contrary, from nuclear synthesis. The processes of radioactive disintegration which are known to us and which lead to the production of heavy inert gases could obviously not account for the total quantity of heavy inert gases in the cosmos.

What could be the source which created the Krypton and Xenon atmosphere on Mars. Two possibilities may be suggested: either they have been present in the Martian atmosphere from the very beginning, or they have been formed on the planet since then. In this case their source can only be radioactive disintegration. We know very little about these processes which result finally in the formation of suitable isotopes of heavy inert gases. In general, the formation of xenon is observed during one variation of disintegration of Uranium: beta disintegration of naturally radioactive potassium leads to the forming of an isotope of argon. However such a form of radioactive disintegration for mubidium is still unknown; although "it would be tempting" to see in this the source of Krypton, since mubidium, for example, is wide spread in very small but perceptible quantities in the silicate rocks of the Earth. Caesium, whose radioactive isotope might lead, during beta disintegration, to the production of xenon, is entirely unstudied in this

respect. However all this does not mean that there may have existed on Mars, in the far areological past, such unstable isotopes of those alkaline metals, which have produced more or less significant quantities of Xenon and Krypton and have already completely disintegrated.

On the other hand there are quite weighty considerations in support of the original existence of a krypton - xenon atmosphere on Mars. Thus, according to many cosmogonists (e.g. H. Alfven) Mars and the Moon have a different origin to that of the Earth, Venus and Mercury. They were formed from a cloud of proto-planetry dust of somewhat different composition - cloud A - consisting of helium with other additions, amongst which one might naturally expect to find the presence of other gases as well. The famous Soviet cosmogonist B.U. Levin points out the huge deficiency of heavy inert gases on Earth by comparison with their abundance in the cosmos. He also points out the uniqueness of the position of Mars, which could not have received her share of heavy substances because of the proximity of massive Jupiter. But there is the question, "Where all these abundance of heavy inert gases were situated in the very beginning?" If they are not on the Earth and Mercury, if we know nothing of their presence on Venus, then will not Mars be permitted to keep a rather larger quantity to herself to counter her lack of heavy substances? And is it not possible in this case for such qualities as their potential for ionisation and high solubility in water plus their ability to form a hard cryohydrate with water at low temperatures to play a definite role. It is relevant to point out that recently L. Borst and W. Edwards made a suggestion that the Moon may have an extremely rare Krypton-Xenon atmosphere. And somewhat earlier H. Brown recognised the great likelihood that argon is the main component of the Martian atmosphere.

3. Certain Properties of the hypothetical Krypton-Xenon Martian Atmosphere

So we suggest that the Martian atmosphere consists in the main of a mixture of Krypton and Xenon (with a preponderance of the first) and an addition of

comparatively small quantities of argon, nitrogen and oxygen. Such an atmosphere in the conditions existing on Earth would be at least twice as dense as the Earth's present one. But allowing for the force of gravity on Mars an atmosphere of such a composition would be only slightly more dense than the Earth's, approaching the density of an atmosphere of $C.O._2$. in the conditions of Earth or Venus. Therefore the breathing regimen for a Martian would be similar to that of a human on Earth.

Furthermore the height of the Earth's so called homogeneous atmosphere (i.e. atmosphere compressed to an uniform density to equal to the density at the Earth's surface) is equal to 8 kilometres. For our hypothesis a heavy atmosphere of this height would be less than 3 km. in the connections on Earth, but the lower forceof gravity on Mars would increase this height almost to that of the Earth's. Therefore the white clouds on Mars are encountered at a height of about 20km., a height of about the same order as the cirrus cloud of the Earth. This means that the extent of the Martian atmosphere, at any rate of its lower layers, is roughly the same as that of the Earth. But the existence of white clouds at heights in the order of 20k.m.'s is difficult to reconcile with the repeated suggestion that the atmosphere of Mars is extremely rarified at a height of 20k.m. If this is so then the existence of white clouds on Mars with such a rarified atmosphere and such a low force of gravity at that height is very strange. Certain other facts lead to the conclusion that the atmosphere of Mars in the lower regions must be of a density similar to that of the Earth. Firstly the wide spread incidence of dust storms in the Martian atmosphere and the long time taken for the dust so raised to settle. With such a rarified atmosphere as is officially suggested this long time for dust to settle after a dust storm would seem a very strange phenomenon, especially when we read that, according to a number of observers, clouds of yellow dust may remain over one and the same quite small area of the planet for several weeks. Such a slow settling in such a rarified atmosphere, even allowing for the smaller force of gravity, can be explained only if we except a number

of dubious interpretations. But if there is a preponderance of heavy gases in the Martian atmosphere then the atmospheric streams and currents, produced by reason of temperature differences, will be very different. On one hand, as a result of the much greater density of the atmosphere than of air on the Earth, these streams will be caused with much more difficulty, because the movement of heavier molecules (more accurately atoms) will slow down more quickly on account of internal friction. But, on the other hand, if the air streams are in any case set into motion they will have more energy and will be able to take up larger particles and in greater quantities. In such a dense atmosphere settling of particles of dust in the layers next to the surface will be slow.

The density gradient of our hypothetical atmosphere will differ very markedly in its steepness from that for the Earth. Indirect evidence of this is given by the fact that, according to H.C. Van de Hulst, the optical thickness of the atmosphere of Mars is about $\frac{1}{3}$ of the Earth's, whilst the altitude of the troposphere (judging from the height of the clouds) does not differ very much from that of the Earth. It is necessary to take into account the fact that the difference in density of the main components of the Earth's atmosphere (nitrogen and oxygen) is not very great - a proportion of 0.97 : 1.10. Therefore, as research in past years has shown, the Earth's atmosphere is homogeneous and does not show stratification even to its greatest altitude; with our hypothetical heavy atmosphere it is another matter. With such a large difference in densities, because of the force of natural diffusion which is undoubtedly more powerful than on Earth (lower force of gravity), the upper parts of the Martian atmosphere will be richer in the lighter gases (oxygen and nitrogen). However since there is only a small amount of these gases in the planet's atmosphere there will still not be much of them in the upper layers. The more dense gases will accumulate in the depressions on Mars, in its "seas", the upper part which will swirl together with atmospheric streams of less dense gases, and from time to time waves of denser gases will "splash"

out onto the level higher regions. Such a picture explains the turbulence often found in the atmosphere of Mars, which is apparently provoked by solar activity. But in normal conditions, as a result of the inertia of the atmosphere, its conditions will be quiet and clear.

We suggest that the depth of the depressions on Mars may reach 20 k.m. If this is the case, even with an atmosphere similar in composition to that of the Earth we can expect the presence of atmosphere of a density very near to the density of the Earth's atmosphere in some high mountainous regions on the Earth, where civilisations have successfully flourished (e.g. the Inca civilisation on the high mountainous plateaux of the South American Andes). Regarding this, it is known that the dark areas of Mars have a considerably higher temperature than the warm ones (10° higher). We can suggest, with certain accuracy, that such a difference is caused not only because they absorb more of the Sun's energy, but also because there is a great thickness of atmosphere above them, caused by the great depth of these "depressions" on the bottom of which rests (according to our hypothesis) a not very thick layer of heavier gases. It is difficult to guess the thickness of these layers, but at the most it isn't more than 1 kilometre. Indirect confirmation of this is given by the fact that the temperature difference between the surface itself and the closest layers of the air is up to 30°. This shows that not only the density gradient but also the temperature gradient is very steep.

The next aspect of this question is the thermal properties of heavy inert gases. In this respect the properties of a krypton-xenon mixture is very interesting. Since the gases possess a low thermal conductivity and low specific heat a body which is heated is such an atmosphere will reach a higher temperature than in oxygen or even argon. It is for this reason that such a mixture is used for filling incandescant electric light bulbs to increase their effectiveness. Sometimes the purpose of this is not correctly understood and it is thought that it is due only to increase the life of the lamp. However it has been clearly pointed out by V.G. Fastovsky that

it permits an increase in temperature of the incandescant filament for the expenditure of the same amount of energy because of the reduction in heat losses, which are a characteristic of other lamp fillings (nitrogen and argon etc.). This allows lamps to be produced with bulbs of a considerably smaller volume.

Thus, because of these properties of krypton and xenon, and if they form a large proportion of the Martian atmosphere, it would be reasonable to expect the abnormally high temperatures of its surface. The temperatures which exist on Mars are, in fact, very difficult to explain without the acceptance of our hypothesis. If the average computed temperature is 14°, then for Mars the average temperature lays between -30° and -50°; but for the warmest, dark areas it increases to +10°, +15 to 20° and even to 30°! In these circumstances the temperature distribution on the actual surface of Mars is extremely interesting, because the Southern hemisphere, which is rich in "seas", is the warmest. Such a range can not be explained solely by the ability of the surface to absorb heat and the astronomic peculiarities of the planet. It can only be explained by the huge depth of the depressions and the existence of an atmosphere of heavy inert gases.

Thus the presence of an atmosphere of heavy inert gases leads to the conclusion that the thermal gradient of the Martian atmosphere will also, in this event, be very steep. This also explains the comparatively high temperatures at the actual surface of the planet and, as L. Spitzer points out, a considerably lower temperature in the upper layers than in the case of Earth. Also the general temperature as a whole will be lower than on Earth. In this connection Mars is rather like a krypton-xenon incandescant lamp with its very small volume of bulb, high element temperature, and very low temperature of bulb glass in comparison. In such a lamp the temperature gradient will also be very steep.

A consequence of the thermal properties of heavy inert gases is that any explosion in their atmosphere will be very vivid. Muraour when producing an experimental explosion in an atmosphere of argon was able to

get a temperature of 10,000° as a result of high compression of argon, low heat conductivity etc. It is interesting that mysterious and unexplained bright flashes are frequently observed on Mars. The presence of a krypton-xenon atmosphere will permit a simple explanation even of these facts - it is the falling of medium sized meteors which enter the dense atmosphere with its poor thermal conductivity.

In conclusion to description of the properties of a krypton-xenon a few words must be said about one peculiarity of these gases. The point is, they have an abnormally high solubility in water and form with it, despite their chemical inertia, compounds with a low stability - cryohydrates. These compounds are hard crystaline substances, stable at low temperatures. The ease with which they are produced increases with an increase in the atomic weight of the gas - as does its solubility. Thus, for example 1 volume of water at 0° will absorb 0.242 volumes of xenon. Such a high degree of solubility must have made a huge difference to the characteristics of the water sources on Mars, whilst at low temperatures we should expect to find not pure ice but cryohydrates, the properties of which have been very little studied. It is extremely likely that the existence of cryohydrates is very closely bound up with several little understood peculiarities of the polar caps of Mars and the white clouds (e.g. the colour of the polar caps, which is unusual for ice) and other peculiarities.

If thinking beings do in fact exist or have existed on Mars, creating a high civilisation and constructing as I.S. Shklovcky suggests, artificial satellites (sputniks) for Mars - Phobos and Daimos, - then the only way to maintain life in the difficult conditions on Mars would be to create an artificial atmosphere of heavy inert gases. For a civilisation which has created such huge artificial satellites the creation and maintenance of an artificial krypton-xenon atmosphere would be a real possibility. It may be that the gases were produced as a result of controlled disintegration of rubidium and caesium, extracted specially for this purpose by plants or bacteria, possibly some sort of methods of nuclear synthesis were used - all

of this is at present only a fantastic hypothesis. But in our opinion (only these gases) in the conditions of Martian reality could solve the problem of a Martian atmosphere suitable for life of thinking beings.

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OBITUARY Jean Gattefosse We much regret to announce the death of Jean Gattefosse (6th May 1960) at Ain es Sebaa, Casablanca, Morocco, from a Stroke. Your editor had been in continuous touch with him by letter for the last 25 years or more, recognising in him one of the main authorities for the various theories linking North West Africa with the Atlantean continent. His novel the "Gates of Bronze" is known to many. Jean Gattefosse with his brother, the late R.M. Gattefosse, were associated with Claudius L. Roux of Lyons, in the Bibliographie de l'Atlantide, published in 1926, which is still the standard source list for most workers in the field.

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